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ABSTRACT

This study was designed to test the hypothesis that students who are given common errors matched with correct performance as part of their instruction in carrying out a procedure will perform better than students who are given only the correct performance. The task was the procedure for correcting color imbalances in color slides, and 56 college sophomores were randomly assigned to either an experimental or a control condition in identical classrooms. For the pretest, students in both groups viewed 10 slides and recorded any color imbalance they perceived. Copies of the standard color wheel were then distributed and a slide tape presentation on the procedure for color correction was given. Both groups received samples of each of the six colors of the standard color wheel and the correct responses for six examples presented following the instruction. In addition, the experimental group received samples of the colors most commonly confused with the six colors and examples of common errors. The data from the pretest and a 20-item posttest were analyzed using a t-test with unequal standard deviations. The results indicated that application-level learning of procedures was significantly facilitated by the presentation of common errors in addition to the examples. It was concluded that the use of common errors is more effective when they are made apparent, or when a clear distinction between a correct and incorrect response is taught. (RP)

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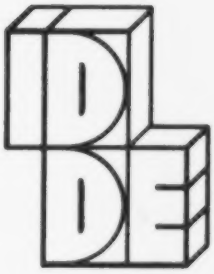

INSTRUCTIONAL DESIGN, DEVELOPMENT, AND EVALUATION

WORKING PAPERS

TEACHING COMMON ERRORS
IN APPLYING A PROCEDURE

by

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IDD&E Working Paper No. 17
October, 1983

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Abstract

The purpose of this study was to explore the use of nonexamples to teach common errors (CE) as an effective strategy in teaching a procedure. A total of 56 sophomore students were randomly assigned to an experimental and a control condition in their regular classrooms. The experimental design was pretest-posttest. Materials and task involved two sets of identical slide projectors and tape recorders to teach the procedure for color correction of color transparencies. The experimental group received instruction on an extra sample of colors most commonly confused with each of the six colors of the standard color wheel. Results indicated that application-level learning of procedures was significantly facilitiated by the presentation of common errors (CE) in addition to examples. In conclusion the use of common errors of great divergence is beneficial. The use of common errors, is more effective when they are made apparent, or when a clear distinction between a correct and incorrect response is taught.

Teaching Common Errors in Applying a Procedure

Several instructional theorists have advocated the pairing of "matched" or "close-in" nonexamples with examples for teaching concepts at the application level (Merrill & Tennyson, 1977; Markle & Tiemann, 1977). In essence, these are pairs of positive and negative instances with minimum within-pair variation of irrelevant attributes (Markle & Tiemann, 1977; Tennyson, 1973; Tennyson, Wooley & Merrill, 1972). Their importance in instruction is that they reduce common errors in learning, specifically overgeneralization (Carnie, 1980a, 1980b). However, a limitation in the use of matched example-nonexample pairs (E-NE) is that the supporting research and theory is established only in the context of concept learning. Would the teaching of common errors, paired with correct performance, also be beneficial for learning procedures and principles at the application level?

The teaching of common errors has in fact been proposed for learning other content types, such as procedures, without specific research support (Gropper, 1983). A literature search revealed no research on the use of matched E-NE for procedure learning nor on the prevention of common errors in learning to use or apply a procedure. Based on the value of matched E-NE for teaching concepts, the authors propose that we can and should prepare learners to avoid common errors in application-level learning as well. The purpose of this study is to test this proposition.

The specific research question is whether or not presenting common errors matched with the correct performance will facilitate procedure (or rule) learning. The independent variable is the presentation of a common error matched with the correct performance of a procedure. The dependent variable is performance of the procedure at the application level (i.e., with previously unencountered instances).

We hypothesize that students receiving presentation of common errors matched with correct performance will perform better than students receiving only the correct performance.

Methods

Students

The students for this study were 34 (15 male and 19 female) second year advertising-design majors from the College of Visual and Performing Arts enrolled in a second semester beginning photography class and 22 (10 male and 12 female) third year students majoring in advertising at the Newhouse School of Public Communications, Syracuse University. Although both groups of students were involved with the production and application of visual media, neither group had prior knowledge about the content area used in this study. The students were asked to participate in a study requiring approximately 25 minutes of normal class time. No payment or grade was associated with the study. On the day of the experiment students willing to participate were randomly assigned by coin tosses to one of two identical lecture rooms.

Design

The research design for this study was the Pretest-Posttest design (Cambell & Stanley, 1963). The statistical design was a t-test with unequal standard deviations (Darlington, 1975).

Task and Materials

The task was the procedure for correcting the color of color slides. It was presented via slide tape machanism utilizing two matched pairs of Kodak Carousel slide projectors and Wollensack slide tape synchronizing machines. The classrooms used for the experiment were identical lecture halls. Light level was controlled to provide adequate illumination for written test responses while still providing for proper slide viewing. Screens were pretested to assure color fidelity. The audio tapes were recorded simultaneously except for the segments of treatment differences. A professional narrator was used for the audio recording.

Valuable lessons were learned during a pilot test. Initially the color slides chosen were copies of a variety of scenic and portrait slides. Variations in color, accomplished by copying the slides through Kodak color correction filters, were the magnitudes .05, .10, and .15 of each of the six colors. In the pilot study a floor effect was achieved for both the common error (CE) and non common error ($\overline{CE}$) groups. After reviewing the results and discussing the study with the pilot study students, the following changes in the materials were incorporated in the final study. First, pilot study students indicated that many of the slides "looked good" even if the color balance was off. Therefore, the variety of slides was limited to only original portraits photographed with identical backgrounds and lighting. Thirty different people were photographed to provide a pool of slides for use. Second, the color magnitude variations of .05, .10, and .15 in the pilot study was difficult for the students to discriminate. In the final study the magnitude of color was changed to .10, .20, and .40 of the six colors using standard Kodak color correction filters. Finally, the instruction was enriched, providing more intense colors for both the CE and $\overline{CE}$ groups.

After the pretest the slide tape presentation provided the purpose of the instruction: "To correct an out-of-balance photograph, add an equal amount of its opposite color." The students were then presented the following steps constituting the procedure:

1) Decide if a color is out-of-balance.
2) Determine which color is out-of-balance.
3) Determine to what degree the color is out-of-balance.
4) Identify the opposite color.
5) Add an equal amount of the opposite color.

All five steps were presented in one slide, with the audio tape instructing the students to read the information presented (see Figure 1).

Insert Figure 1 about here

Each of the steps was then presented individually on the left side of the screen with an example of that step provided visually on the right half of the screen. At the same time the audio tape provided a description of the example. No practice was provided.

Treatments

Instruction was identical for both the CE and $\overline{CE}$ groups, with two exceptions. First, in step two of the generality for the procedure, the $\overline{CE}$ group only received a sample of each of the six colors. The CE group received a sample of each of the six colors and at the same time were presented samples of the colors most commonly confused with each of the six colors. The audio tape cautioned CE students not to confuse the colors (i.e., not to make the common error). Samples of the CE and $\overline{CE}$ presentation are provided in Figure 2.

Insert Figure 2 about here

On the basis of color photography teaching experiences and the results of the pilot study, the common errors were determined to be adjacent colors on the standard color wheel (see Figure 3).

Insert Figure 3 about here

The second difference between the two groups occurred with the examples. After completing the instruction for the five steps of the procedure, six examples were provided. The $\overline{CE}$ group was provided with only the color imbalance (i.e., the correct response) in the examples. The CE group was presented with the same color imbalance (correct response) and with the common errors. Figure 4 provides examples of the CE and $\overline{CE}$ presentations.

Slide Left	Slide Right
1. (step 1)* 2. 3. 4. 5.	1a. Look for neutral tones (white, gray, flesh tones). 1b. Compare that color to your mental image for color inconsistencys.

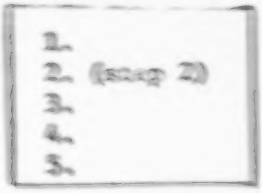
Narration:

In order to determine if a transparency's color is out-of-balance, look at the specific areas in the photograph which have identifiable color or neutral hues, such as gray, white or flesh tones. For example, in a portrait flesh tones should look natural without color cast.

* In the actual slide all five steps were presented as described in the text of this article. In this case, step one was highlighted.

Figure 1. An example of the slides presented and the narration provided.

(CE)



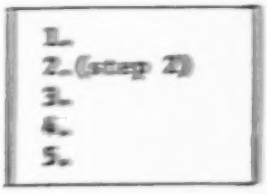
Slide Left

Slide Right

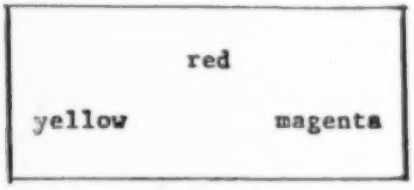
Narration:

The next six slidesets will present the actual colors of the color wheel. Try to create a mental image of the colors as they are presented. The actual colors are presented on the right. In this slide the color red is shown.

(CE)



Slide Left



Slide Right

Narration:

The next six slide sets will present the actual colors of the color wheel. Try to create a mental image of the colors as they are presented. The actual colors are presented on the right. In this slide the color red is shown at top center with yellow on the left and magenta on the right. At times, the color red is confused with magenta or yellow.

Figure 2. A comparison of the slide sets and narration.

Common Errors

COLOR	COMMON ERROR
red	magenta or yellow
green	yellow or cyan
blue	cyan or magenta
cyan	green or blue
magenta	red or blue
yellow	green or red

Figure 3. At left-the six colors, at right-the adjacent colors on the color wheel.

Insert Figure 4 about here

Tests and Measures

The slides for a ten-item pretest, a twenty-item posttest (Figure 5), and the six examples were selected at random from a pool of slides generated for that purpose. All test slides were portraits of Caucasian subjects holding a white, gray, and black test card. Slides varied in magnitude of imbalance from neutral (no color imbalance) to .10, .20, and .40. The type of imbalance varied from red, green, blue, cyan, magenta, and yellow. Color variation was controlled by the use of the standard Kodak color correction filters. All subjects were photographed with identical lighting and background.

Procedure

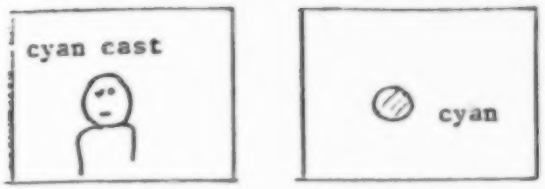
After random assignment to two separate classrooms, students were distributed a pretest form (see Figure 5). Instructions for the administration of the pretest were provided by slide tape. Students viewed the slides and responded by recording the color imbalance, if any, they perceived. Following the pretest, the students were distributed a copy of the standard color wheel (see Figure 6). The slide tape presentation on the procedure for color correction was then give. Finally, students were administered the twenty item posttest requiring them to indicate the color imbalance, if any (see Figure 7).

Insert Figures 5, 6, and 7 about here

Results

The small sample and different cell sizes indicated that the t-test with unequal standard deviations would be appropriate. Analysis of the pretest results revealed no significant differences between the groups ($t=0.87$, $p>.20$). Analysis of the posttest results revealed that application-level learning, as shown by the number of correct responses, was facilitated by the presentation of common errors in instruction ($p<.05$, one tail). Further, a review of the individual posttests provided data indicating that there was a lower number of common errors (as opposed to uncommon errors) in the CE group ($p<.05$, one tail). The hypothesis as stated in the introduction section is thus supported.

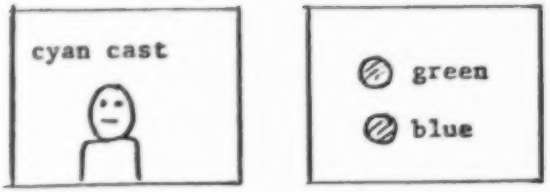
($\overline{CE}$)



Slide left Slide right

Narration instructed the $\overline{CE}$ group to compare the color imbalance only with the correct response. They did not view the common errors.

(CE)



Slide left Slide right

Narration instructed the CE group to compare the color imbalance in the slide with the colors most commonly confused with the color imbalance.

Slide left Slide right

The CE group then viewed the color imbalance with the corredt response.

Figure 4. A comparison of $\overline{CE}$ and CE slide sets.

Social Security No. _____

Please follow the instructions given to you by the autio tape.

1) _____

2) _____

3) _____

4) _____

5) _____

6) _____

7) _____

8) _____

9) _____

10) _____

Figure 5. The pre-test form.

Figure 6. The color wheel previded to students.

Social Security No. _____

1. a) Color balance (circle one)

Neutral Red Green Blue Cyan Magenta Yellow

b) Degree:

.05 .10 .15

c) The amount and color necessary to accomplish color corrections.

color _____ _____ amount of correction

2. a) Color balance (circle one)

Neutral Red Green Blue Cyan Magenta Yellow

b) Degree:

.05 .10 .15

c) The amount and color necessary to accomplish color corrections.

color _____ _____ amount of correction

...

19. a) Color balance (circle one)

Neutral Red Green Blue Cyan Magenta Yellow

b) Degree:

.05 .10 .15

c) The amount and color necessary to accomplish color corrections.

color _____ _____ amount of correction

20. a) Color balance (circle one)

Neutral Red Green Blue Cyan Magenta Yellow

b) Degree:

.05 .10 .15

c) The amount and color necessary to accomplish color corrections.

color _____ _____ amount of correction

Figure 7. The post test form.

Insert Table 1 about here

Discussion

The results of this study show that performance significantly increased as a result of the presentation of common errors in instruction for procedure learning at the application level. The number of common errors was reduced by appropriate teaching of such errors. The results of this study support Gropper (1983), strengthening the hypothesis that the teaching of common errors may be a valuable strategy for other than concept learning (i.e., procedures or principles) at the application level.

Unique to this study was the selection of materials that allowed for very specific control of variables. The slides produced for this study were identical in every respect except for a variety of faces and color. Changes in color were controlled in measured increments. This level of control rarely exists in other contexts.

Given the results of the pilot study of the present study, we conclude the following. First, presentation of common errors of great divergence is beneficial. Second, common errors should be just that, errors commonly made for the procedure. It is pointless to teach mistakes that are generally not made. Finally, the use of common errors is most valuable when the common error is made apparent and a clear distinction exists between a correct and incorrect response.

Further research is needed to determine the value of teaching common errors in principle learning, as well as replicating this research in procedure learning. In conducting such research, particular care should be addressed to the accurate identification of common errors.

Table 1

		MEAN	S.D.	N.
$\overline{CE}$	Pretest*	11.25	12.68	16
	Posttest**	42.20	10.82	18
	Common Errors**	6.05	1.89	18
CE	Pretest*	14.50	9.73	20
	Posttest**	48.75	9.73	20
	Commor Errors**	4.90	1.67	20

* % score out of ten questions.
** % score out of twenty questions.

Pretest CE vs. Pretest $\overline{CE}$

t= .87 df= 17 $p > .20$ one tail

Posttest CE vs. Posttest $\overline{CE}$

t= 1.95 df= 17 $p < .05$ one tail

Common Errors CE vs. Common Errors $\overline{CE}$

t= 1.99 df= 17 $p < .05$ one tail

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